AD 286 702

63-1-2

GENERAL DYNAMICS | CONVAIR

Report No. 8926-029

Materials - Coatings And Finishes - Organic - Primers, Corrosion Inhibiting - Lacquer And Epoxy Resin Vehicle - Zinc Chromate Pigment

Chromate Leaching Under Accelerated Weathering Conditions

M. A. Mc Gowan, N. Nalley, W. M. Sutherland

15 May 1961

Post Office Box 1950, San Diego 12, California CYpress 6-6611
Material Post Office Box 2071 BRoadway 3-8000 | Accounting Post Office Box 510

Report No. 8926-029

Materials - Coatings And Finishes - Organic - Primers, Corrosion Inhibiting - Lacquer And Epoxy Resin Vehicle - Zinc Chromate Pigment

Chromate Leaching Under Accelerated Weathering Conditions

Abstract

The preparation of Chromium 51 tagged zinc chromate pigment in accordance with Mil-P-8585 for use in lacquer vehicle primer, and a proprietary calcium chromate pigment for use in epoxy resin vehicle primer is described along with the preparation of the corrosion inhibiting primers used. Radio-active counts were used to determine chromate losses and weight differences were used to determine primer losses resulting from humidity cabinet and salt spray cabinet exposures. Chromate loss from aluminum surfaces took place at a slow rate. During the first week in the humidity cabinet about 0.7% of the chromate ion left the surface per day and from the 6th through the 7th week, the rate of loss was almost constant at 0.1% per day.

References:

1. Mc Gowan, M. A., Nalley, N., Sutherland, W. M., "Leaching of Chromate From Aluminum Primers Under Accelerated Weathering Conditions - Investigation Using Radioactive Tracers," General Dynamics/Convair Report MP 61-052, San Diego, California, 15 May 1961 (Reference attached).

2. Mc Gowan, M. A., Sutherland, W. M., "Leaching of Chromate From Aluminum Primers Under Accelerated Weathering Conditions - Investigation Using Radioactive Tracers," General Dynamics/Convair Report MP 61-052 Add. 1, San Diego, California, 18 September 1961 (Reference attached)

3. Braley, W. C., George, J. C., Price, B. J. Hibert, C. L. "Coatings, Epoxy, Skydrol Resistant And Corrosion Preventative," General Dynamics/Convair Report 0-03021, San Diego, California, 2 February 1958 (Reference attached).

CONVAIR
A DIVISION OF GENERAL DYNAMICS CORPORATION
SAN DIEGO

REPORT MP-61-052
DATE 15 May 1961
MODEL F-106

TITLE

REPORT NO. MP-61-052

LEACHING OF CHROMATE FROM ALUMINUM PRIMERS UNDER ACCELERATED WEATHERING CONDITIONS INVESTIGATION USING RADIOACTIVE TRACERS

MODEL: F-106

CONTRACT NO. AF 33(600)-36546

PREPARED BY M. A. McGowan
M. A. McGowan

GROUP Materials & Processes Lab.

Checked by: Nuri Malley
Nuri Malley, Dept. 190-2

REFERENCE P. R. #940

CHECKED BY W. M. Sutherland
W. M. Sutherland
Group Engineer

APPROVED BY W. H. Steurer
W. H. Steurer
Chief of Engineering Matls.

NO. OF PAGES 7

NO. OF DIAGRAMS 3

REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED

FORM 1812A-4

ccl

INTRODUCTION:

Surface finishes containing a chromate pigment are unequalled in their ability to inhibit corrosion on aluminum.

The basic corrosion inhibiting agent in these finishes is the chromate ion. The chromate-containing pigment is sparingly soluble in water, and in service as a paint or other finish it continuously supplies chromate to the surface over a long period of time as moisture from the atmosphere acts as a solvent on the dried paint film.

The rate at which chromate is released from the pigment is determined not only by the pigment concentration but by the solubility of the specific pigment in use.

The duration of corrosion protection cannot however be estimated from the pigment solubility and its concentration in the dried paint film. The type of resin or oil used in the paint may, through a variety of mechanisms, alter the rate of release of chromate to the surface or its removal from the surface.

This project studies the rate at which chromate ion is lost from a primed aluminum surface under weathering conditions by using a zinc chromate primer, MIL-P-8585, made with a zinc yellow pigment which has been tagged with radioactive chromium. Chromate concentration on the surface is determined by radio assay.

OBJECT:

1. To prepare in the laboratory a zinc chromate primer conforming to MIL-P-8585 which has a zinc yellow pigment tagged with chromium -51.

2. To expose aluminum surfaces treated with the above zinc chromate primer to weathering conditions in a humidity cabinet and salt spray apparatus, and to determine the rate at which chromate ion is lost from the surface.

3. To prepare an epoxy primer conforming to Convair Specification 0-03021H containing as a pigment calcium chromate tagged with chromium -51.

4. To expose aluminum surfaces coated with the above epoxy primer to weathering conditions identical to those for the test of zinc chromate primer for the same purpose.

5. To evaluate the data in the case of each primer and to compare them as corrosion inhibitors.

PROCEDURE:

The incorporation of radioactive chromium into the primers as a tracer demanded that it be added to the chromate salt from which the pigment was synthesized. To do this, the pigment had to be synthesized in the laboratory. This procedure made it necessary to use, as a control in the testing, a non-active primer which had also been prepared from laboratory synthesized pigment.

In the case of both the zinc chromate primer and the calcium chromate epoxy primer, the pigment manufacturers were asked to supply the production method for producing the respective pigments. DuPont Chemicals - Pigments Division supplied the relevant information on zinc yellow and the Mineral Pigments Corp. of Muirkirk, Maryland, provided that on calcium chromate pigment. The methods were then adapted to a laboratory operation.

A. Preparation of Zinc Chromate Primer (MIL-P-8585)

1. Preparation of Zinc Yellow Pigment - The basic pigment in zinc chromate primer (MIL-P-8585) is a zinc chromate-potassium oxide salt having the emiperical formula:

$$4\ ZnO\text{-}4\ CrO_3\text{-}K_2O\text{-}3H_2O$$

The pigment was prepared by a modification of a method suggested by Mr. J. Flenn of DuPont Pigments Division in Pasadena.

A quantity of ZnO in a water slurry was processed in a colloid mill for one-half hour with the gap between the rotor and stator surfaces of the instrument set at a distance of .00046". The milled ZnO slurry was then added to a water solution of $K_2Cr_2O_7$ and CrO_3. The weights of the compounds in the mixture were in the stoichiometric ratio of the zinc yellow salt. Following the addition of the ZnO, the mixture was stirred mechanically for 24 hours, filtered and dried at 150°F. The product was weighed and the filtrate analyzed for chromium content. The composition of the pigment was calculated from this data and the calculations appear in Table I.

2. Preparation of Tagged Zinc Yellow Pigment - The zinc yellow pigment containing chromium -51 as a tracer was prepared in the same way as the inactive pigment. The tracer was added in the form of K_2CrO_4 to the dichromate-chromic acid solution before mixing in the ZnO. The chromate content of the filtrate in this instance was calculated by radioactive assay, and the composition of the radioactive pigment determined from this data and the weights of the starting materials and the product. These calculations also appear in Table I.

PROCEDURE: (Continued)

A. Preparation of Zinc Chromate Primer (MIL-P-8585) (Cont'd)

3. Preparation of Zinc Chromate Primer Using Laboratory Prepared Pigments - The primers containing both the radioactive pigment and the inactive pigment were made according to a proprietory formula supplied by a vendor, The Andrew Brown Co. The extender pigment was ground in a ball mill with resin and solvent. Specified quantities of zinc yellow pigment and the above mixture were blended together with other primer components with a mortar and pestle.

4. Application of Primer - After preparation, the zinc chromate primers were diluted 1:2 with toluene according to MIL-P-8585 and applied to the specimens by dipping. Specimens had been previously cleaned with MEK and treated with a wash primer, MIL-C-8514. The specimens were air dried and weighed before and after dipping to determine the amount of dried paint on the surface.

5. Specimens - The specimens used for the test were 4.5 cm diameter discs of aluminum alloy 2024S-T3 clad, .063" gauge. A small hole was drilled near the edge of the discs so that they might be suspended by wire or string for dipping and testing.

6. Test Apparatus and Procedure -

a) Humidity Cabinet - Control samples of specimens coated with commercial zinc chromate primer and inactive laboratory prepared zinc chromate primer were placed in the humidity cabinet together with 15 specimens which had been coated with radioactive zinc chromate primer. Beakers were placed below specimens of tagged primer to collect the condensate which drained from the discs.

The humidity cabinet was operated in accordance with specification JAN-H-792. Tagged specimens were assayed for radioactive concentration before being placed in the cabinet and removed at intervals and counted to determine loss of chromate from the surface.

b) Salt Spray Apparatus - Control specimens and test specimens corresponding to those exposed in the humidity cabinet were placed in a salt spray apparatus and tested in accordance with Federal Test Method Standard 151, Method 811 (20% NaCl). The tagged specimens were followed for chromate loss in this test as in the humidity chamber test.

PROCEDURE: (Continued)

B. Preparation of Epoxy Primer (0-03021H)

1. Preparation of Calcium Chromate Pigment - The basic pigment in the epoxy primer considered is a calcium chromate salt prepared from CaO and CrO_3. Detailed instructions for preparing the pigment were secured from Dr. H. E. Wiesberg of the Mineral Pigments Co. who regularly supply the pigment which is used in the commercial primer. Mineral Pigments Co. has offered to prepare a radioactive primer for laboratory costs only if the quantity of tracer is shipped to them. Both the instructions for preparing the pigment and the letter offering to prepare a tagged primer are on file in the Materials and Processes Lab.

2. Preparation of Epoxy Primer Using Non-Active Pigment - Using non-active calcium chromate pigment and a grind paste and let down resin supplied by the vendor, a laboratory preparation of epoxy resin was made.

3. Application of Laboratory Epoxy Primer - After preparing the primer as described above, an equal quantity of curing agent was added and the primer was applied to a number of aluminum discs by dipping. The weight of dried paint film on the specimens was determined and they were set aside to be used as controls in humidity and salt spray testing of the tagged primer to be prepared later.

4. Specimens - The specimens which were coated with epoxy primer were identical with those used for zinc chromate primer evaluation.

NOTE: The test data from which this report was prepared are recorded in Materials & Processes Laboratory Data Book No. 3081.

TABLE I

PREPARATION OF ZINC YELLOW PIGMENT

$4\ ZnO\text{-}4\ CrO_3\text{-}K_2O\text{-}3H_2O$

A. Non-Active Pigment

Reagents	Weight	Moles
ZnO	13.00 gm	.16
$K_2Cr_2O_7$	11.76 "	.04
CrO_3	8.00 "	.08
H_2O(crystallization)	2.16 "	.12

Weight of Product - Theoretical	34.92 gm
Weight of Product - Actual	32.60 gm
Percent Yield	93.5%

Calculation of Composition of Product

Excess Cr in Supernate = 1.38×10^{-2} moles
50% of excess as CrO_3 = 0.69 gm
50% of excess as K Cr O = 1.01 gm

Total Weight of Unreacted Material = 1.70 gm

Transfer Loss = Wt. Reagent - (Wt. Product + Wt. Unreacted)

= 34.92 - (32.60 + 1.70) = 0.62 gm

$$\text{Percent Transfer Loss} = \frac{0.62}{32.60 + 0.62} \times 100 = 1.87\%$$

Excess ZnO in Pigment

Reagent	Weight	Less Loss to Supernate	Less Transfer Loss (1.87%)	Moles in Product
ZnO	13.00 gm	13.00	12.76	.1568
$K_2Cr_2O_7$	11.76	10.75	10.55	.0359
CrO_3	8.00	7.31	7.17	.0718

Excess ZnO = .1568 - (.0718 + 2(.0359) = .0132 moles =1.07 gm
% Excess ZnO in Product = $\frac{1.07}{32.60}$ = 3.28%

Composition of Pigment: 96.72% Zn Yellow
3.28% ZnO

TABLE I (Continued)

PREPARATION OF ZINC YELLOW PIGMENT

$4\ ZnO\text{-}4\ CrO_3\text{-}K_2O\text{-}3H_2O$

B. Radioactive Pigment

Reagents	Weight	Moles
ZnO	3.25 gm	.04
$K_2Cr_2O_7$	2.94	.01
CrO_3	2.00	.02
H_2O (crystallization)	.54	.03

Weight of Product - Theoretical 8.73 gm
Weight of Product - Actual 8.39 gm
Percent Yield 93.5%

Tracer Concentration in Reagents

$$\frac{\text{Tracer}}{\text{Total Cr}} = \frac{0.715 \text{ mc}}{2.98 \text{ gm Cr}} \quad \text{(as of 4/10/61)}$$

$$= 3.43 \times 10^{-4} \text{ millicuries } Cr^{51}/\text{mg Cr}$$

Calculation of Composition of Product

Excess Cr in Supernate (radioassay) = 0.0162 mc = 47.2 mg

50% of excess as CrO_3 = 90.8 mg
50% of excess as $K_2Cr_2O_7$ = 133.5 mg

Total Wt. Unreacted Material = 0.143 gm

Transfer Loss = Wt. Reagent - (Wt. Product + Wt. Unreacted) = 8.73

-(8.39 + .14) = 0.20 gm

$$\text{Percent Transfer Loss} = \frac{0.20}{8.39 + 0.20} \times 100 = 2.33\%$$

TABLE I (Continued)

PREPARATION OF ZINC YELLOW PIGMENT

$4\ ZnO\text{-}4\ CrO_3\text{-}K_2O\text{-}3H_2O$

B. Radioactive Pigment (Cont'd)

Reagent	Excess ZnO in Product: Weight	Less Loss to Supernate	Less Transfer Loss (2.33%)	Moles in Product
ZnO	3.25 gm	3.25	3.17	.0387
$K_2Cr_2O_7$	2.94 gm	2.81	2.74	.0093
CrO_3	2.00 gm	1.91	1.87	.0187

Excess ZnO = .0387 - (.0187 + 2 (.0093) = .0014 moles = 0.114 gms

% Excess ZnO in Product = $\frac{.114}{8.39}$ = 1.36

Composition of Pigment = 98.64% Zn Yellow
1.36% ZnO

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

SAN DIEGO

REPORT MP-61-052 ADD.1

DATE 18 September 1961

MODEL F-106

T.N. MP-61-052

TITLE

REPORT NO. MP-61-052
ADDENDUM 1

LEACHING OF CHROMATE FROM ALUMINUM PRIMERS UNDER ACCELERATED WEATHERING CONDITIONS INVESTIGATION USING RADIOACTIVE TRACERS

MODEL: F-106

CONTRACT NO. AF 33(600)-36546

PREPARED BY M. A. McGowan

GROUP Materials & Processes Lab.

REFERENCE

CHECKED BY W. M. Sutherland
Group Engineer

APPROVED BY W. H. Steurer
Chief of Engineering Materials

NO. OF PAGES 8

NO. OF DIAGRAMS 6

REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED

FORM 1612A-4

ccl

INTRODUCTION:

Refer to Report MP-61-052.

OBJECT:

Refer to Report MP-61-052.

PROCEDURE:

A zinc chromate primer containing radioactive chromium -51 as a tracer was prepared. This procedure is described in detail in the previous report.

SPECIMENS:

The specimens to which the primer was applied were 4.5 cm. diameter discs of 2024S-T3 clad aluminum of .063" gauge. A small hole was drilled near the edge of each disc so that they could be suspended by string from racks in the test chambers. Before application of the primer, the specimens were cleaned with methyl ethyl ketone and treated with a wash primer, MIL-C-8514.

APPLICATION OF PRIMER:

The specimens described above were air-dried and weighed. The radioactive primer was diluted with toluene as specified in MIL-P-8585 and applied by dipping the specimens. The primer coated specimens were air dried and weighed and the amount of primer on the surface computed.

In addition, control specimens were prepared in the same manner, substituting non-active zinc chromate primer which had been prepared in the laboratory and also commercial primer, MIL-P-8585.

TEST APPARATUS AND PROCEDURE:

Fifteen specimens of aluminum coated with radioactive zinc chromate primer were placed in both the humidity cabinet and the salt spray cabinet together with non-active controls. Beakers were placed below each of the radioactive specimens to collect the condensate which drained from the discs.

The humidity cabinet was operated in accordance with JAN-H-792. The salt spray apparatus was operated in accordance with Federal Test Method Standard 151, Method 811 (20% NaCl).

COUNT OF RADIOACTIVE SPECIMENS:

A few of the aluminum discs which had been coated with radioactive primer were reserved as counting standards.

The radioactivity on the specimens which were exposed to weathering was determined before placing them in the chambers. Specimens were removed from the chambers at regular intervals for counting. After 26 days the specimens were removed from the salt spray cabinet and that test terminated. The loss of chromate from these specimens was so slow that it was obvious an excessive amount of time would be used in gathering additional information from the test.

The test in the humidity cabinet was continued for a total of 50 days.

The specimens from both tests were air dried and weighed at the conclusion of the test.

The chromate loss, determined by radioassay, and the total primer loss, determined by weight difference, were tabulated and plotted for both humidity and salt spray conditions. This information is contained in Tables I-III and Figures 1-3.

Radioactive specimens were counted to a total count sufficient to give a statistical accuracy of 1%.

RESULTS AND CONCLUSIONS:

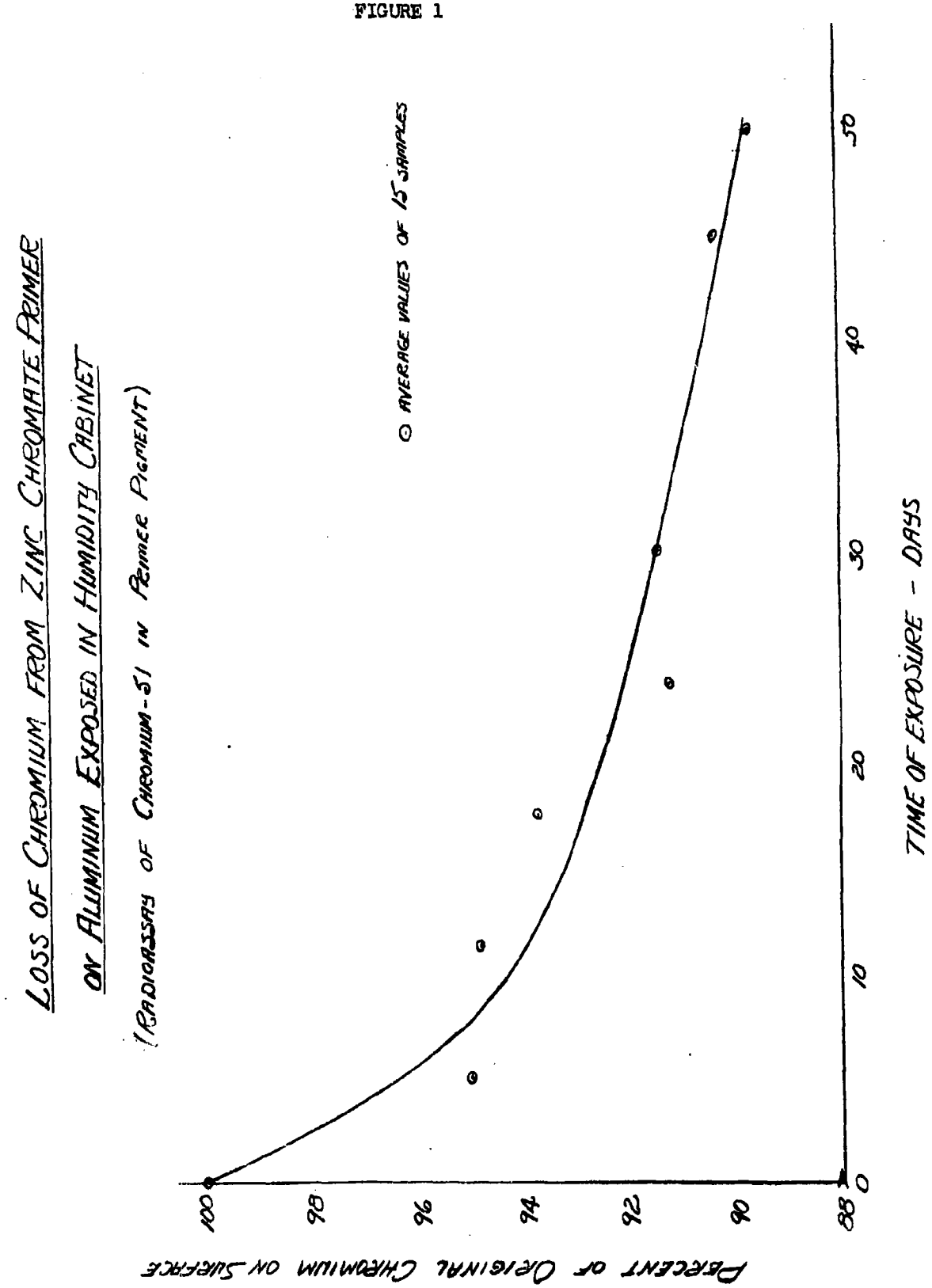
Chromate is lost from the aluminum surface at a rather slow rate. During the first week in the humidity cabinet, the chromate ion left the surface at about 0.7%/day. This was the highest rate of loss during the test. From the 6th through the 7th week when the rate of loss had become almost constant, chromate disappeared at about 0.1%/day.

The most significant information from the test is the high ratio of chromium retained to total pigment material retained on the surface. This ratio corresponds quite closely for both tests.

The chemical state of the retained chromium, the mechanism by which it is transferred from the primer pigment, and its site of retention are undetermined.

Note: Data from which this report was written are recorded in Materials & Processes Laboratory Notebook #3081.

FIGURE 1


LOSS OF CHROMIUM FROM ZINC CHROMATE PRIMER
OR ALUMINUM EXPOSED IN HUMIDITY CABINET
(RADIOASSAY OF CHROMIUM-51 IN PRIMER PIGMENT)
O AVERAGE VALUES OF 15 SAMPLES
PERCENT OF ORIGINAL CHROMIUM ON SURFACE
100
98
96
94
92
90
88
0
10
20
30
40
50
TIME OF EXPOSURE - DAYS

LOSS OF CHROMIUM FROM ZINC CHROMATE PRIMER ON ALUMINUM EXPOSED IN SALT SPRAY CABINET

(RADIOASSAY OF CHROMIUM-51 IN PRIMER PIGMENT)

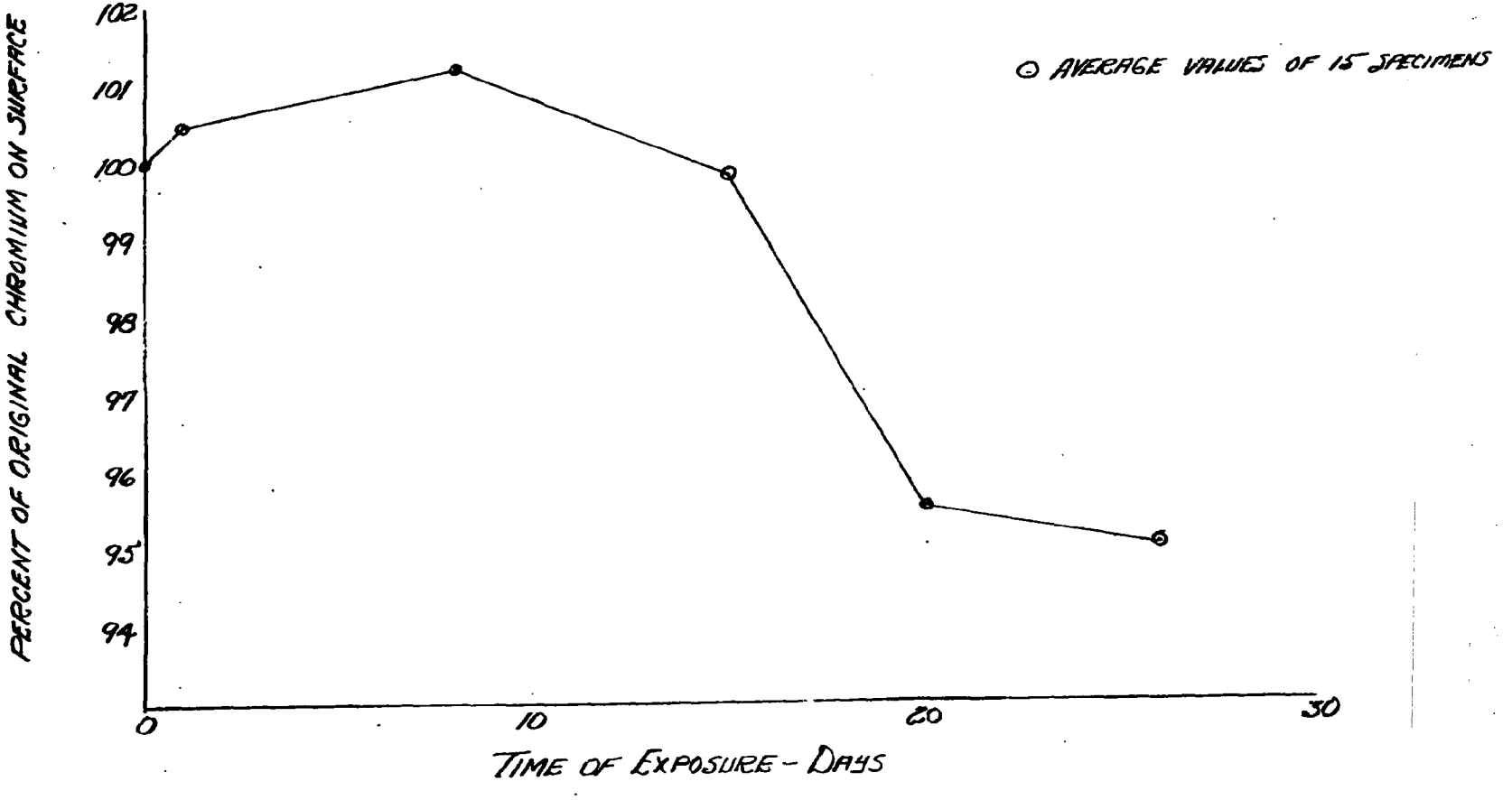


FIGURE 2

FIGURE 3

Comparison of Chromium and Total Zinc Chromate Primer Retained on Aluminum Surfaces after Exposure to Weathering
Salt Spray Cabinet : 26 days
Humidity Cabinet : 50 days
Percent of Original Material Remaining on Surface
100
80
60
40
20
0
96.4%
Chromium by Radiassay
91.9%
Total Primer by Weight
89.6%
Chromium by Radiassay
74.5%
Total Primer by Weight
Chromium Retained / Total Primer Retained : Salt Spray = 1.18 Humidity Cabinet = 1.20

TABLE I

LOSS OF STRONTIUM FROM ZINC CHROMATE PRIMER ON ALUMINUM EXPOSED IN HUMIDITY CABINET

(RADIOASSAY OF CHROMIUM-51 IN PRIMER PIGMENT)

Specimen No.	Initial Activity counts/min.	Percent of Initial Activity Remaining after Exposure						
		4 Days	11 Days	16 Days	23 Days	30 Days	44 Days	50 Days
RH 1	9980	96.7	95.6	94.4	91.6	90.3	90.8	96.0
RH 2	6877	98.7	97.4	95.7	94.7	94.1	92.3	93.9
RH 3	7404	96.6	97.6	93.1	92.3	93.4	93.2	93.4
RH 4	9494	96.1	99.0	95.4	93.9	93.7	89.6	92.2
RH 5	8865	94.5	90.4	89.9	89.4	90.2	85.9	88.2
RH 6	7366	94.7	93.7	93.7	93.7	91.7	88.6	89.6
RH 7	7102	98.6	94.8	96.8	89.5	94.5	91.9	90.7
RH 8	8157	94.2	94.0	92.6	87.8	89.2	86.7	86.5
RH 9	6829	92.8	92.9	94.0	89.0	89.6	89.8	86.9
RH 10	11,269	95.5	94.9	92.5	92.5	90.9	90.3	89.0
RH 11	6615	93.4	93.7	94.4	91.0	92.5	90.4	90.6
RH 12	6311	92.5	94.0	91.9	90.3	88.8	92.9	92.6
RH 13	6387	92.9	94.5	90.8	87.5	87.6	89.7	86.9
RH 14	5387	93.1	91.3	91.2	90.8	89.2	87.8	89.2
RH 15	6421	95.0	98.3	98.5	94.1	95.4	95.1	91.5

TABLE II

Loss of Chromium from Zinc Chromate Primer on Aluminum Exposed to Salt-Spray Conditions

(Radioassay of Chromium-51 in Primer Pigment)

Specimen No.	Initial Activity Counts/Min.	Percent of Initial Activity Remaining After Exposure				
		1 Day	8 Days	15 Days	20 Days	26 Days
RS1	6604	100.4	97.3	101.4	95.5	92.4
RS2	6350	100.0	102.0	100.0	94.6	94.5
RS3	8654	99.9	101.7	94.3	95.0	96.6
RS4	7656	100.9	101.5	101.8	89.2	94.7
RS5	7440	102.4	103.6	101.5	97.3	97.1
RS6	7520	100.9	99.0	102.4	97.1	93.8
RS7	7100	100.1	100.5	101.6	100.9	95.7
RS8	8204	100.2	105.2	103.9	97.4	98.3
RS9	7293	102.9	102.4	102.5	98.3	93.1
RS10	7017	100.8	100.0	97.1	96.2	91.7
RS11	7102	99.9	101.0	98.3	94.9	96.5
RS12	7161	97.8	100.5	99.1	95.5	93.8
RS13	7216	102.1	102.7	99.8	93.8	96.4
RS14	7849	98.2	96.9	93.7	93.5	93.3
RS15	5463	101.6	103.5	99.4	94.6	96.4

1st Coat Zinc Chromate Primer Retained on Aluminum Surfaces After Exposure to Weathering

Salt Spray Cabinet : 26 Days

Sample	Initial Wt.	Final Wt.	Percent Primer Left on Surface
RS1	.0203	.0166	82.1
RS2	.0201	.0167	82.9
RS3	.0236	.0187	79.2
RS4	.0214	.0166	77.6
RS5	.0210	.0161	76.6
RS6	.0223	.0174	78.1
RS7	.0219	.0182	82.8
RS8	.0231	.0180	78.0
RS9	.0206	.0158	76.5
RS10	.0215	.0166	77.3
RS11	.0207	.0161	77.6
RS12	.0170	.0130	76.0
RS13	.0212	.0172	81.3
RS14	.0225	.0183	81.2
RS15	.0241	.0197	81.4

Humidity Cabinet : 30 Days

Sample	Initial Wt.	Final Wt.	Percent Primer Left on Surface
RH1	.0258	.0181	73.4
RH2	.0204	.0153	73.1
RH3	.0217	.0163	73.1
RH4	.0229	.0169	73.9
RH5	.0227	.0168	74.0
RH6	.0210	.0156	74.0
RH7	.0217	.0165	76.1
RH8	.0208	.0154	74.3
RH9	.0194	.0143	74.0
RH10	.0296	.0245	76.2
RH11	.0196	.0126	73.6
RH12	.0194	.0149	77.0
RH13	.0197	.0146	74.2
RH14	.0188	.0133	71.0
RH15	.0203	.0149	73.0

TABLE III

22

CONVAIR
A DIVISION OF GENERAL DYNAMICS CORPORATION
SAN DIEGO

SPEC.NO. 0-03021
DATE 2 February 1958
MODEL All

TITLE

COATINGS, EPOXY, SKYDROL RESISTANT
and
CORROSION PREVENTIVE

PREPARED BY W. C. Braley
W. C. BRALEY
J. C. George
J. C. GEORGE
CHECKED BY B. J. Price
B. J. PRICE

GROUP STANDARDS
REFERENCE
APPROVED BY G. T. Waite
G. T. WAITE

C L Hibert
C. L. HIBERT

NO. OF PAGES 9
NO. OF DIAGRAMS

REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED
J	11-1-61		Completely revised	All CR 11-26-61

FORM 1618A-4

COATINGS, EPOXY, SKYDROL RESISTANT and CORROSION PREVENTIVE

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

2. APPLICABLE DOCUMENTS: Where other specifications or publications are referenced in this specification the issue in effect on the date of invitation for bids shall be applicable.

3. TYPES AND CLASSES: Material shall conform to the following types and classes:

Type 1 - Primer

Type 2 - Pigmented Enamel

Class A - High Gloss

Class B - Semigloss

Class C - Nonspecular (Lusterless)

Type 3 - Clear Enamel (formerly Type 2 - Clear)

Type 4 - Moly Black (formerly Type 2 - Moly Black)
Compounded by ball mill mixing 30 parts by weight of Molykote Type Z (manufactured by Alpha Molykote Corp., Stamford, Conn.) with 70 parts of Type 3 resin.

Type 5 - Teflon Clear (formerly Type 2 - Teflon Clear)
Compounded by ball mill mixing 5 parts by weight DuPont de Nemours and Company "Teflon 5" molding powder, 40 mesh screened, with 95 parts of Type 3 resin.

4. MATERIAL: The material shall consist of two separately packaged components, one an epoxy resin and the other a converter-thinner, to be mixed by equal volume prior to use. Each shall be free from skins, lumps, grit and foreign contaminants and shall be capable of being easily mixed to form a smooth, homogeneous, readily sprayable liquid.

5. PHYSICAL PROPERTY REQUIREMENTS:

5.1 UNMIXED COMPONENTS:

5.1.1 TOXICITY: If toxic ingredients cannot be avoided all necessary precautions shall be clearly noted on the containers.

5.1.2 STABILITY: Unopened containers stored at a temperature range of 40 to 100°F for periods up to one year shall be capable of meeting

all requirements of this specification.

5.1.3 WEIGHT: When tested in accordance with FED-STD-141, Method 4184, the weights of the two components shall conform to the following:

EPOXY RESIN COMPONENT

Type 1- 11 - 12 1/2 lbs/gal

Type 2 - 9 - 12 lbs/gal

Type 3 - 8 1/2 - 9 1/2 lbs/gal

Type 4 - 9 1/2 - 10 1/2 lbs/gal

Type 5 - 8 1/2 - 9 1/2 lbs/gal

CONVERTER - THINNER COMPONENT

All Types - 6.5 - 7.5 lbs/gal

5.2 MIXED MATERIAL: After mixing the components by equal volume the material shall meet the following requirements.

5.2.1 NONVOLATILES: When tested in accordance with FED-STD-141, Method 4041, the nonvolatiles shall not be less than the following:

Type 1 - 41% by weight

Type 2 - 51% by weight

Type 3 - 51% by weight

Type 4 - 51% by weight

Type 5 - 51% by weight

5.2.2 FINENESS OF GRIND: When tested in accordance with FED-STD-141, Method 4411, the fineness of grind shall conform to the following:

Type 1 - 5 1/2 mils minimum

Type 2 - 7 mils minimum

Type 3 - not applicable

Type 4 - 7 mils minimum

Type 5 - not applicable

5.2.3 VISCOSITY: When tested at 75 ±5°F using a Number 1 Zahn cup, the viscosity shall conform to the following:

	UP TO 1 HOUR AFTER MIXING	UP TO 8 HOURS AFTER MIXING
Type 1	36 ±4 seconds	50 seconds max.
Type 2	36 ±4 seconds	70 seconds max.
Type 3	36 ±4 seconds	70 seconds max.
Type 4	36 ±4 seconds	70 seconds max.
Type 5	36 ±4 seconds	70 seconds max.

5.3 SPRAYED COATINGS:

5.3.1 STANDARD CONDITIONS: Coatings of Type 1 and of Type 2, 3, 4 or 5 applied over a primer coat of Type 1, sprayed (1 to 8 hours after mixing) at a temperature of 75 ±5°F and a relative humidity of 50 ±15%, and cured at 75 ±5°F for 48 hours shall meet the following requirements when applied with a film thickness of .4 to .6 mils for Type 1 and 1 to 1.5 mils for all other types. Conformance shall be demonstrated via test panels as defined in 6.5 and 6.6.

5.3.1.1 DRYING TIME: When tested in accordance with FED-STD-141, Method 4061, the material shall air dry within the following maximum time limits:

	DUST FREE	TACK FREE	DRY THROUGH
Type 1 -	10 minutes	15 minutes	30 minutes
Type 2 -	30 minutes	3 hours	6 hours
Type 3 -	30 minutes	3 hours	6 hours
Type 4 -	30 minutes	3 hours	6 hours
Type 5 -	30 minutes	3 hours	6 hours

5.3.1.2 GLOSS (TYPE 2 ONLY): When tested in accordance with FED-STD-141, Method 6101, the specular gloss rating of Type 2 coatings shall be as follows:

Type 2 - Class A - 90 min.

Class B - 55-65

Class C - 15 max.

5.3.1.3 COLOR: When compared with color chits the coatings shall be as follows:

Type 1 - shall conform to FED-STD-595 color number 33814

Type 2 - shall conform to any FED-STD-595 color specified or shall match such other color chits as are specified and supplied by General Dynamics/Convair.

Type 3 - shall be natural clear.

Type 4 - shall be color resulting from specified compounding.

Type 5 - shall be color resulting from specified compounding.

5.3.1.4 ADHESION: There shall be no loss of adhesion of the coating when tested in accordance with the following. Bend a test panel through 180 degrees over a 1 inch diameter mandrel, straighten panel by pressing it down by hand on a flat surface then subject the bent area of the coating to a tape test per FED-STD-141, Method 6301, except that water immersion shall be omitted.

5.3.1.5 SKYDROL RESISTANCE:

5.3.1.5.1 WETTING: After daily application (by brush or spray) of Skydrol 500 for 10 consecutive days the coating shall have a minimum pencil hardness of H without visible marring of the surface when tested in accordance with para. 5.3.1.5.3.

5.3.1.5.2 IMMERSION: After immersion in Skydrol 500 for 10 consecutive days the coating shall have a minimum pencil hardness of H without visible marring of the surface when tested in accordance with para. 5.3.1.5.3.

5.3.1.5.3 PENCIL HARDNESS TEST: Pencil hardness tests shall be conducted with drafting pencils (manufactured by the Eagle Pencil Company of New York, N.Y.) having approximately 3/8 inch of exposed, undamaged lead the tip of which has been carefully squared by holding the pencil in a vertical position and moving it back and forth over 400 grit sandpaper. The test shall be performed by holding a pencil of the minimum hardness specified at a 45 degree

angle and pushing it across the coated surface with a pressure just under that required to crush or break the lead.

5.3.1.6 FLUID IMMERSION: After immersion in the following fluids for 10 days there shall be no loss of adhesion when tested in accordance with para. 5.3.1.4, and no softening, wrinkling or visual evidence of film failure:

(a) Distilled water

(b) MIL-S-3136, Type III Test Fluid

(c) MIL-L-7808, Jet Engine Oil

(d) MIL-H-5606, Hydraulic Fluid

5.3.1.7 CORROSION RESISTANCE: When tested in accordance with FED-STD-141, Method 6061, for a period of 500 hours, there shall be no loss of color, blistering, softening, nor any corrosion along either side of the scribe mark. In addition there shall be no loss of adhesion when tested in accordance with para. 5.3.1.4. Furthermore test panels removed from the salt spray cabinet after 240 hours and carefully stripped of the coating shall show no evidence of corrosion.

5.3.1.8 WEATHEROMETER RESISTANCE: When tested in accordance with FED-STD-141, Method 6152, for a period of 120 hours for Type 1 and 240 hours for all others there shall be no blistering or significant color change. In addition, there shall be no loss of adhesion when tested in accordance with para. 5.3.1.4 and in the case of Type 2, Class A, the specular gloss after washing with lukewarm soap solution using a soft sponge shall be 75 minimum when tested in accordance with para. 5.3.1.2.

5.3.1.9 HEAT RESISTANCE: After baking for 70 hours at 350 ±10°F there shall be no blistering and no loss of adhesion when tested in accordance with para. 5.3.1.4.

5.3.1.10 LOW TEMPERATURE RESISTANCE: When subjected to -70 ±5°F for 5 hours and tested in accordance with 5.3.1.4 (using a mandrel cooled to -70 ±5°F) there shall be no loss of adhesion nor any visual evidence of film failure.

5.3.1.11 HUMIDITY RESISTANCE: When tested in accordance with FED-STD-141, Method 6201, at 120 ±5°F with condensing humidity conditions for 10 days there shall be no softening, blistering, loss of color or other visual evidence of film failure. In addition, there shall be no loss of adhesion

when tested in accordance with para. 5.3.1.4.

5.3.2 LOW TEMPERATURE - HIGH HUMIDITY CONDITIONS: In addition to the requirements of para. 5.3.1, Type 1 coatings sprayed at a temperature of 65 ±2°F and a relative humidity of 75 ±2%, cured at 50 ±2°F and 85 ±2% relative humidity for 20 hours followed by additional curing at 75 ±5°F for 48 hours shall meet the following requirements: (Also see para. 10)

(a) Distilled Water Immersion - Para. 5.3.1.6(a)

(b) Skydrol Resistance, Para. 5.3.1.5.1 and 5.3.1.5.2

(c) Corrosion Resistance, Para. 5.3.1.7

(d) Humidity Resistance, Para. 5.3.1.11

6. QUALITY ASSURANCE PROVISIONS:

6.1 QUALIFICATION TESTS: Qualification tests shall consist of all those listed in Section 5 of this specification.

6.2 ACCEPTANCE TESTS: Acceptance tests shall be performed upon representative samples of each batch of material received and shall consist of the following plus such others as may be deemed necessary by the General Dynamics/ Convair Quality Control Department to insure conformance to the requirements of this specification.

(a) Weight (5.1.3)

(b) Nonvolatiles (5.2.1)

(c) Viscosity (5.2.3)

(d) Drying Time (5.3.1.1)

(e) Gloss (5.3.1.2)

(f) Color (5.3.1.3)

(g) Adhesion (5.3.1.4)

(h) Skydrol Resistance (5.3.1.5.1) (5.3.1.5.2)

(i) Distilled Water Immersion (5.3.1.6a)

(j) Corrosion Resistance after 240 hours (5.3.1.7)

(k) Humidity Resistance (5.3.1.11)

(l) Low Temperature - High Humidity Conditions (5.3.2)

6.3 QUALIFIED PRODUCTS: Only those products as listed in Appendix 1 of this specification are qualified and approved for procurement under this specification.

6.4 REQUESTS FOR QUALIFICATION: All requests for qualification shall be directed to the General Dynamics/Convair Material Department, attention of the Buyer whose name appears on the invitation to bid. Such requests shall include a test report showing conformance to all requirements of this specification and shall be accompanied with test samples consisting of two quarts of each type for which qualification is requested.

6.5 TEST PANELS: All panels used for test purposes shall be .040 x 3 x 9 inch clad 2024 aluminum alloy conforming to QQ-A-362, except that panels for the corrosion resistance and humidity tests shall be bare 7075 aluminum alloy conforming to QQ-A-283.

6.6 TEST PANEL PREPARATION: Immediately prior to application of the coating the surface of the test panels shall be cleaned with a clean cheesecloth dampened with MEK (methyl-ethyl-ketone) conforming to TT-M-261, followed by additional cleaning with the three-step Number 376 cleaning system as manufactured by Tec Chemical Company, 524 South Monterey Pass Road, Monterey Park, California. The 376 system cleaning shall be accomplished as follows:

(a) Apply a wet coat of "Remover H" and wipe dry with clean, dry cloth.

(b) Apply a wet coat of Number 376 surface conditioner and allow to dry for 2 to 10 minutes.

(c) Remove 376 coating by wiping with a clean cloth saturated with clean tap water or by flushing.

(d) Allow panel to air dry.

If necessary prior to applications of Type 2, 3, 4 or 5 coatings over Type 1, the surface shall be cleaned with a clean cheesecloth dampened with aliphatic naptha conforming to TT-N-95, and wiped dry.

7. IDENTIFICATION: Each container shall be marked with the following information:

(a) 0-03021

(b) Resin or converter

(c) Type

(d) Color and Class (Type 2 only)

(e) Manufacturer's name and product number

(f) Batch number and date of manufacture

(g) Complete instructions for use

8. REPORTS: The vendor of the product shall submit with each shipment three copies of a report stating that the material conforms in all respects to the requirements of this specification and that the materials and manufacturing methods used are the same as those submitted for qualification. The report shall include the results of all inspection tests performed at the vendor's facility to insure conformance and shall list the purchase order number, material specification number, vendor's name, and the batch number and date of manufacture.

9. REJECTION: Material not conforming to the requirements of this specification will be subject to rejection.

10. NOTES:

10.1 It is General Dynamics/Convair's desire to also be able to procure Types 2, 3, 4 and 5 material capable of meeting the requirements of para. 5.3.2 and notice is hereby served that preference will be given to those vendors developing such products.

APPENDIX I

Only the following products are qualified and approved for procurement under this specification:

TYPE	MFGR. DESIGNATION	MFGR. NAME and ADDRESS
1	Super Koropon No. 765	DeSoto Chemical Coatings, Inc. Berkeley, California
1	Super Jet Skin No. 162-Y-22	W. P. Fuller and Co. San Francisco, California
2	A-423	Andrew Brown Company Los Angeles, California
3	A-423	Andrew Brown Company Los Angeles, California
4	A-423 Moly Black	Andrew Brown Company Los Angeles, California
5	A-423 Teflon Clear	Andrew Brown Company Los Angeles, California